

The insect remains active from July to December if the niger crop is available in the field. It remains most active from September to November, when the crop of normal sowing season remains in flowering stage and 15 to 20 per cent seeds were found to be damaged by the fly. Being a direct pest infesting grains

which are ultimately utilized, it seems to be more destructive than *P. capensis* and *U. compositae* which are indirect pests of niger.

I am thankful to the Director, Commonwealth Institute of Entomology, London for the identification of the pest.

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20. OVIPOSITION OF TWO CHIRONOMIDS (DIPTERA) IN THE LABORATORY

The oviposition of chironomid midges is little known in comparison to the other aspects of biology studied in the laboratory (Oliver 1971). There is no record on the oviposition of chironomids in India and less attention has been paid to the biological aspects and oviposition in particular. The present study is aimed at clarifying oviposition in two Indian chironomids, *Chironomus barbatitarsis* Kieffer and *C. filitarsis* Kieffer in the laboratory. This study provides some information on the mechanism of oviposition and its behaviour during oviposition.

A stock colony of the insects was maintained in the laboratory for study. The gravid females were allowed to lay eggs in encaged culture trays — Petridishes containing tap water having 2-3 floating paper strips. As soon as the larvae emerged, they were transferred to another cage of similar nature containing water on a bed of sterilised mud and thin layer of fine sand. The larvae were fed with ground rabbit chow, fila-

mentous algae. A little amount of Bakers' yeast was also used for food. This was repeated for obtaining the stock culture.

The chironomids laid eggs in masses and the number of egg masses was one to many. The egg masses were cylindrical and the number of which was one but often a second, though small, was found to be deposited by the females of *Chironomus barbatitarsis*. However, in both the species the egg masses were provided with suspensory stalk and anchoring chord. The number of eggs within an egg mass varied from 400 to 500 in *C. barbatitarsis* and 150 to 250 in *C. filitarsis*. The eggs in the masses were oriented in a spiral fashion in the former and in 5-6 longitudinal rows in the latter species. The ovipositional behaviour was studied in the following three phases and both the species showed more or less similar pattern of behaviour.

Preovipositional behaviour — As soon as the females were released in the cages

in the laboratory, they were seen to perform a very short flight after which some of them took their position on the wall of the cage. About 40% of the females rested on the floor of the cage while others were seen to wander inside the cages. The petridishes/pots in the culture were provided with water having some floating paper strips. The insects remained as such for 20-50 minutes after which most of them approached the petridishes and the others remained on the wall and floor of the cage where some of them ultimately died. The chironomids near the culture pots were seen to move a little for about 10-20 minutes and then rested on the floating strips of paper or at the edges of the dishes or over the water surface. Some individuals were noticed to return to the net or the floor of the cage without laying the eggs. These females died after 2-3 days which were recorded to be their life span.

Behaviour during oviposition: At the onset of oviposition the genitalia was placed over water and the hind legs were set apart. Immediately before release of eggs the insects moved a few steps forward so that the egg mass remained attached to the floating papers. The individuals remaining near or at the edges of the pots also placed their genitalia just on the upper water level and laid their egg masses approximately 0.5 mm above the water surface. A few females floating over the water deposited the egg masses there in water and little movements of legs and antennae were observed.

Postovipositional behaviour: As soon as the oviposition was completed most of the females returned to the wall or floor of the cage within 2-3 minutes after oviposition. Some of them

remained quiet and a few were often seen to perform little flight in captivity. As such the chironomids lived for 2-3 days (*C. barbatitarsis*) and 1-2 days (*C. filitarsis*) after which the insects died. Vigorous movements of the chironomids were noticed before death of the individual. The remaining females which were still on the paper strips even after egg deposition also remained quiet or sometimes showed short leaping movements over the sites. Finally, they died on the water surface with the eggs carried on the legs. These insects were found to last for 2-10 hours only. The insects with the egg masses stuck to the body were seen to sink in the water.

As reported by Macan (1961) the selective oviposition behaviour occurred in a number of aquatic insects and the present *Chironomus* spp. were not an exception. According to Curry (1956), Dyson & Lloyd (1936) and Fryer (1959) chironomids preferred floating objects for egg deposition which did agree with our observations made during this study. In addition to those, it was noticed that the laying of eggs also took place over the water without any object and at the edge of the water. The species of *Chironomus* oviposited in between 18-23 hours and they exhibited dial periodicity in respect to egg laying. The time of oviposition was therefore marked from the evening to midnight and sometimes also in the dawn and at dusk.

Sincere thanks are due to Prof. Ole A. Saether, University of Bergen (Norway) for kindly going through the manuscript and to the Head of the department of Zoology for laboratory facilities.

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21. LIFE HISTORY, EPHIPPIA DEVELOPMENT, CYCLOMORPHOSIS AND TEMPERATURE EFFECT ON LIFE CYCLE IN *DAPHNIA LUMHOLTZI* SARS (CLADOCERA: DAPHNIDAE)

(With two plates & a text-figure)

INTRODUCTION

Fish production in aquatic ecosystem de-pends largely upon the secondary link in the aquatic food chain, which constitutes impor-tant fish food organisms. Cladocerans are the main components of this phase of organic pro-duction which have nutritional values for the growth and production of fish. Although the importance of Cladocera as fish food, both for fry and adults, has been stressed by different workers (Alikunhi 1952, Pennak 1953, Hutchin-son 1967, Kanaujia 1979), only scanty infor-mation is available on their seasonal abun-dance, life-cycle, cyclomorphosis and sexual reproduction in natural freshwater environment in tropical regions. In India, Michael (1962), Murugan (1973, 1975), Murugan & Sivarama-krishnan (1975, 1976), Navaneethakrishnan & Michael (1971), and Kanaujia (MS) have studied the life cycle, biology and seasonal abundance of various species of Cladocera. Observations made on the life-cycle, including effect of seasonal temperature, ephippial de-velopment and cyclomorphosis in *Daphnia lum-holtzi* under laboratory and field conditions, and results obtained are presented in this paper.

MATERIAL AND METHOD

Daphnia lumholtzi collected from a fish pond at Cuttack, India (Long. 85°52'E, Lat. 20° 29'N) was used for the study. An egg-bearing female was reared separately in 1-litre beaker with the same pond water. Newly released young ones were reared individually in 20 beakers of 100 ml capacity filled with pond water filtered through No. 25 Nylobolt silk cloth. The filtered pond water contained minute nannoplankters. (*Chlorella* sp., *Scenedesmus* sp. and *Tetraspora* sp.) besides detritus, which served as food for the reared specimens. Water in the beakers was changed once every 24 hours. Observations were recorded on dura-tion of each instar, length increment at each instar, total number of instars, number of young ones in each brood, total life span and water temperature.

For the study of different stages of embryo-nic development a hundred egg-bearing females were reared in a 10-litre glass jar. The deve-losing embryo was dissected out of the brood sac and various stages were photomicrographed.

Another set of experiments was conducted